

AQ-SPEC

Air Quality Sensor Performance Evaluation Center

Sensor Description

Manufacturer/Model:
TSI AirAssure
Model IPM2.5

Pollutants:
PM_{2.5}

Measurement Range:
5 - 300 µg/m³

Type: Optical



Additional Information

Field evaluation report:

<http://www.aqmd.gov/aq-spec/evaluations/field>

Lab evaluation report:

<http://www.aqmd.gov/aq-spec/evaluations/laboratory>

AQ-SPEC website:

<http://www.aqmd.gov/aq-spec>

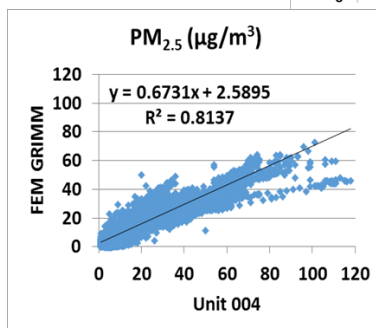
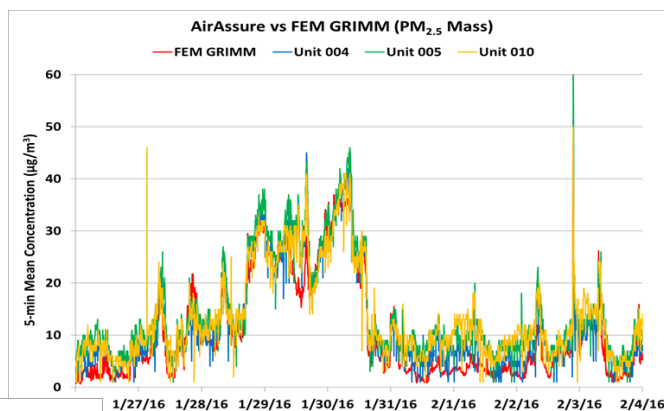
Evaluation Summary

- Overall, the three AirAssure sensors showed low accuracy. They overestimated the FEM GRIMM PM_{2.5} measurements for a concentration range between 0 to 150 µg/m³. When the PM_{2.5} concentration was higher than 150 µg/m³ (measured by GRIMM), the AirAssure plateaued at 300 µg/m³.
- The three AirAssure sensors exhibited high precision for most of the tested T/RH combinations in the environmental chamber.
- AirAssure sensors (units IDs: 004, 005, 010) showed low intra-model variability in the field deployment. However, in the laboratory testing, units IDs 5036, 7003, and 7004 showed moderate to high intra-model variability.
- AirAssure sensors had good data recovery (>99% for 5-min average in the field, and >97% for 1-min average in the laboratory).
- For PM_{2.5}, the AirAssure sensors had high correlation with the reference instrument from both the field ($R^2 > 0.81$) and laboratory studies ($R^2 > 0.99$).

Field Evaluation Highlights

- Deployment period 12/18/2015- 02/15/2016: the three AirAssure sensors (units IDs: 004, 005, 010) correlated well with PM_{2.5} concentration change as monitored by GRIMM and BAM.
- The units showed > 99% data recovery as well as low intra-model variability.

$R^2 > 0.81$



Coefficient of Determination (R^2) quantifies how the three sensors followed the PM concentration change by GRIMM.

An R^2 approaching the value of 1 reflects a near perfect agreement, whereas a value of 0 indicates a complete lack of correlation.

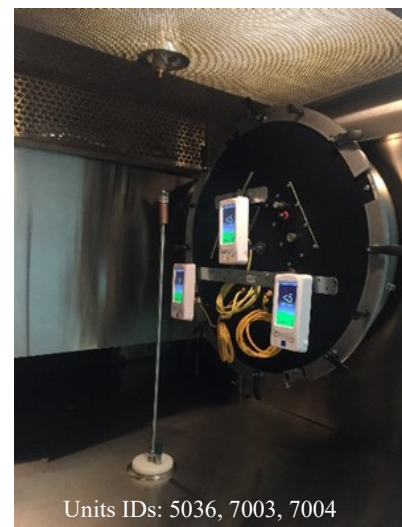
Laboratory Evaluation Highlights

Accuracy

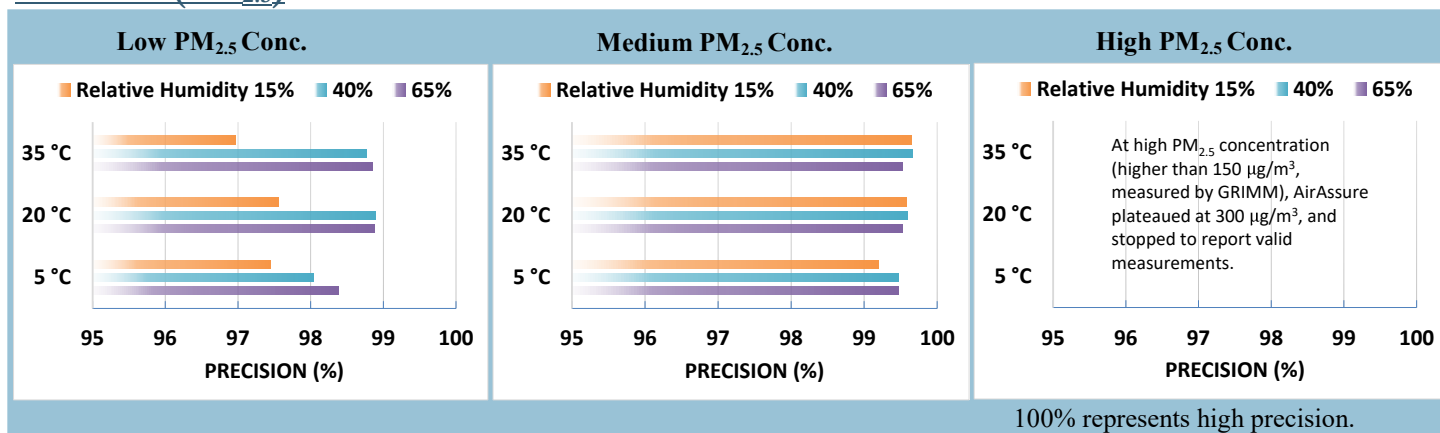
$$A (\%) = 100 - \frac{|\bar{X} - \bar{R}|}{\bar{R}} * 100$$

Steady State (#)	Sensor mean (µg/m³)	GRIMM (µg/m³)	Accuracy (%)
1	37.4	12.1	-108.1
2	77.3	32.7	-36.5
3	157.7	73.3	-15.2
4	295.9	142.8	-7.2

Accuracy was evaluated by a concentration ramping experiment at 20 °C and 40%. The sensor's readings at each ramping steady state are compared to the reference instrument. A negative % means that sensors overestimate reference instrument's reading by 2 folds.

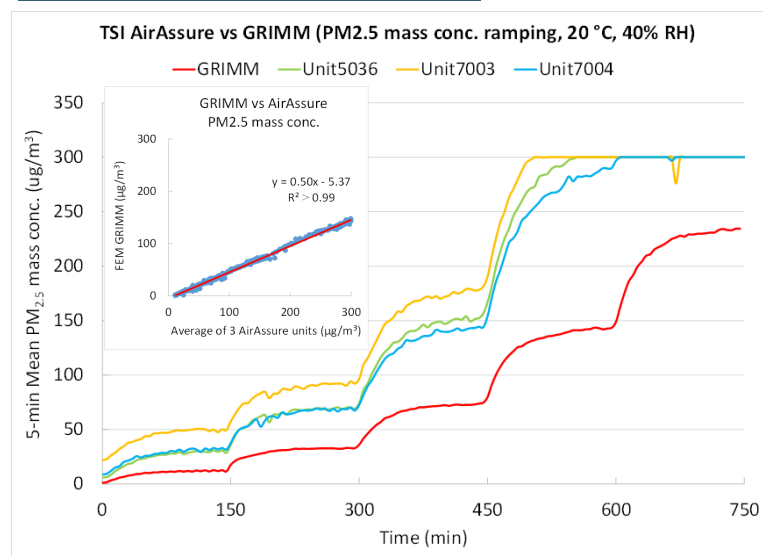


Precision (PM_{2.5})



Sensor's ability of generating precise measurements of PM concentration at low, medium, and high pollutant levels were evaluated under 9 combinations of T and RH, including extreme weather conditions like cold and dry (5 °C and 15%), cold and humid (5 °C and 65%), hot and humid (35 °C and 65%), or hot and dry (35 °C and 15%).

Coefficient of Determination



The three AirAssure sensors showed excellent correlation with the corresponding FEM PM_{2.5} data ($R^2 > 0.99$) at 20 °C and 40% RH.

Climate Susceptibility

From the laboratory studies, temperature and relative humidity had minimal effect on the AirAssure sensors' precision. At the set-points of RH changes, AirAssure reported spiked changes in concentrations.

Observed Interferents

N/A



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